CHOOSING AMONG RELATED FOILS IN APHASIA: THE ROLE OF COMMON AND DISTINCTIVE SEMANTIC FEATURES

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This study investigated the nature of semantic feature knowledge in persons with aphasia. The relationship between feature knowledge and the ability to choose among semantically related foils was also examined. In addition, the relationship between semantic feature knowledge and comprehension and naming abilities was investigated. Participants completed tasks including choosing among unrelated and related foils and a sorting task involving common and distinctive features controlled for mid and low importance. The primary hypothesis was that participants who have difficulty choosing among semantically related foils would have significantly more difficulty with the identification of distinctive features than common features. The findings support the primary hypothesis in that those participants who had difficulty choosing among semantically related foils were significantly more impaired with the identification of distinctive features than the group who were able to choose among semantically related foils. The participants who had difficulty choosing among related foils were also significantly more impaired with identification of distinctive versus common features. In addition, the group who were able to choose among semantically related foils did not have a significant difference between the identification of distinctive versus common features. Importance was not a significant factor when comparing mid- importance to
low-importance features for either group. Comprehension scores were also significantly correlated with distinctive feature identification. These results suggest that distinctive feature knowledge contributes in a significant way to the integrity of semantic representations in people with aphasia, influencing their comprehension, and, perhaps, naming abilities. Potential clinical implications of these results were discussed.
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CHAPTER I
INTRODUCTION AND REVIEW OF THE LITERATURE

How semantic representations are stored and processed is an area of interest in aphasiology. Deficits in semantic knowledge are often a symptom of aphasia. In order to research semantic feature knowledge in persons with aphasia, one must first define the semantic levels of processing. Nickels (2001) posited a model of speech production that involves processing at levels of conceptual semantics, lexical semantics, lemma, and phonological form. This model will be used for the purposes of this research and is shown in Figure 1. The model and following comments are based on this chapter (Nickels, 2001).

![Figure 1](image)

*Figure 1.* Model of speech production discussed in Nickels (2001).

The conceptual-semantics level involves processing of pre-verbal conceptual representations that are independent of language. These representations include
encyclopedic, contextual, and situation knowledge of the concept. For the purposes of this paper, the term concept will refer to these prelinguistic representations.

Most, but not all, concepts can be represented by a lexical entry or word. For example, a male swan is called a con. However, there is no lexical entry for the concept of a male robin. In addition, there is no single lexical entry for the concept of a four-wheel vehicle despite its prominent role in our society. The meaning associated with a lexical entry is processed in the lexical-semantics level. Lexical-semantic representations are often impaired in persons with aphasia which can affect their ability to comprehend or produce those lexical items. However, this impairment usually occurs in conjunction with relatively intact conceptual-semantic representations as shown by the fact that persons with aphasia use the objects (e.g., a ball or pen) correctly.

The existence of a lemma level and its function are currently debated. It is usually considered to be an “empty” node that can activate appropriate semantic, syntactic, and phonological information for a specific lexical entry. The phonological form level involves processing of phonological information needed to articulate the word. Discussion of these levels of processing is beyond the scope of this paper. The purpose of the present study is to analyze the nature of lexical-semantic representations, particularly in terms of semantic feature knowledge, in persons with aphasia. These representations will also be referred to as simply semantic representations or semantic knowledge.

Deficits in semantic knowledge are often a symptom of aphasia. It has become widely accepted that lexical-semantic representations are essentially made up of semantic features (Smith, Shoben & Rips, 1974; McNamara & Sternberg, 1983). Yet, very few
studies have examined how an underlying deficit in semantic feature knowledge may impact a person with aphasia. This chapter will first review the role of semantic features in semantic representations. The chapter will then address the use of semantic feature knowledge in the treatment of aphasia. The chapter will also examine the classifications of semantic features studied in the normal population. The chapter will also address the ability to choose among semantically related and unrelated foils and how it relates to semantic feature knowledge. The chapter will conclude by presenting the rationale and research questions of the present study.

Semantic Features

As discussed earlier, how semantic representations are processed in the brain is a topic of interest in aphasiology. Semantic knowledge refers to a large domain of knowledge acquired about the world, including facts, conceptual knowledge, and beliefs (Martin, 2001). In turn, lexical-semantic knowledge can be defined as the linguistic information stored in our brains that defines a representation as a distinct entity (e.g., specific type of food, item of furniture, animal) (Martin, 2001). Semantic representations include information about an object’s category, use, action, properties, location, and associations; thus, the representation is essentially made up of semantic features. For example, when defining couch one could use the features furniture, sit on it, sits three people, and found in living room.

The notion that these representations are comprised of features has become central to the study of lexical-semantic knowledge. The idea that representations are composed of bundles of semantic features (McNamara & Sternberg, 1983) has been
investigated extensively using normal adults. Several feature-based models of semantic knowledge have been investigated (Hampton, 1979, 1987; Miller & Johnson-Laird, 1976; Smith & Medlin, 1981; Smith et al., 1974). Smith et al. (1974) proposed that features could be classified as distinguishing or characteristic in nature. Miller and Johnson-Laird (1976) distinguished between perceptual and abstract features. Smith and Medlin (1981) proposed a probabilistic feature model that weighted features according to a combination of their salience and the probability that they occur with a member of a representation. Hampton (1979, 1987) used importance ratings to classify semantic features.

These feature-based models rely on the assumption that semantic representations are composed of features and that representations can be defined by encoding a system of features or meaning components. For example, when defining dog, one might use the features has four legs, has a tail, and barks.

Some persons with aphasia have comprehension and word-finding problems that may relate to deficits in semantic feature knowledge. Therefore, the idea of using features to define semantic representations has been incorporated into treatment for the word-finding problems traditionally associated with aphasia (Boyle & Coelho, 1995; Coelho, McHugh & Boyle, 2000; Conley & Coelho, 2003; Boyle, 2004). These studies have investigated the efficacy of semantic feature based treatments for persons with aphasia.

**Semantic Feature Treatment Approaches**

Semantic Feature Analysis is a treatment technique used to improve the retrieval of underlying semantic knowledge by accessing semantic networks (Boyle & Coelho, 1995). In this technique, a person with aphasia is encouraged to produce words
semantically related to a target word (group, use, action, properties, location, and association) (Boyle & Coelho, 1995). This treatment technique may be beneficial for word retrieval problems because it activates the semantic feature network surrounding the target. This heightened semantic activation may lead to more successful activation of the phonological representation for the target word.

Boyle and Coelho (1995) used Semantic Feature Analysis with a person with mild non-fluent aphasia and found improved confrontation naming of trained and untrained pictured objects. However, no generalization was made to connected speech. Coelho, McHugh, and Boyle (2000) subsequently used Semantic Feature Analysis to improve confrontation naming of pictured objects with a person with a moderate fluent aphasia secondary to a closed head injury. The number of stimuli presented during treatment sessions was also manipulated to determine if using a large number of stimuli during treatment would promote generalization more effectively than using a small number of stimuli in each session. Gains were made in the confrontation naming of both trained and untrained stimulus items. The authors found that Semantic Feature Analysis was also associated with modest improvements in measures of connected speech. In addition, the authors reported that generalization to untreated items was greater when only a small number of stimuli were trained.

Conley and Coelho (2003) studied an individual with chronic Broca’s aphasia using Semantic Feature Analysis and the forward chaining technique of Response Elaboration Training. The authors defined Response Elaboration Training as a treatment technique focusing on the elaboration of self-initiated spontaneous responses, forward
chaining, and reinforcement of the content, rather than the form, of responses. The authors stated that the combination of Semantic Feature Analysis and Response Elaboration Training was intended to elicit a targeted response by activating a semantic network without inhibiting related or creative responses.

Conley and Choelho (2003) used this combination of Semantic Feature Analysis and Response Elaboration Training with a fifty-seven-year-old female who was eight years post-onset of a left cerebrovascular accident and demonstrated a moderate to severe Broca’s aphasia. The authors reported that the combined treatment approach resulted in improved naming of the treated pictured objects as well as the untreated pictured objects. During a follow-up phase, it was found that the treatment effect was maintained at a higher level for the treatment pictures than for the untreated pictures. The authors suggested that the combined treatment approach was effective in improving the ability of the individual to retrieve object names.

Boyle (2004) investigated Semantic Feature Analysis with one individual with anomic aphasia and one individual with Wernicke’s aphasia. The author reported that confrontation naming of treated pictured objects improved and generalized to untreated pictured objects for both participants. In addition, both participants improved in some aspects of connected speech.

The results of these studies suggest that a semantic-feature approach is efficacious for the treatment of word finding deficits in aphasia. However, determination of the best way to classify or organize features to maximize semantic-based treatment approaches for word finding deficits has not been widely studied. Psycholinguists have studied how
normal adults classify semantic features; however, only a small number of studies have been published regarding how features could be classified for treatment of aphasia. Four ways to classify features will be described in further detail: importance of features, centrality of features, relevance of features, and distinctive versus shared features.

Importance of Features

Hampton (1979, 1987) examined the importance of semantic features in the normal population. He found that features could be systematically ranked for importance when used to define a lexical entry. Feature importance was determined by a series of surveys filled out by normal adults to determine high and low importance features for lexical entries (e.g., SPORTS-GAMES) and their conjunctions (e.g., SPORTS THAT ARE ALSO GAMES). High-importance features were those that were rated as very important to the definition of the representation and/or necessarily true of all possible examples of the representation. Low-importance features were those that were rated as less important to the definition of the representation and/or necessarily true of only some examples of the representation. In addition, Hampton (1979) showed that features identified as being common to all possible examples of a category had higher ranked importance than those only present in the typical examples. Hampton (1979) also showed that the mean ranked importance of features correlated significantly with the frequency with which the features were produced.

Germani and Pierce (1995) expanded upon the findings of Hampton (1979, 1987) by investigating semantic feature knowledge in thirteen persons with right hemisphere damage, thirteen persons with left hemisphere damage and aphasia, and thirteen persons
with no history of brain damage. Twenty normal persons completed surveys to determine importance ratings for the features used in the study. Examples of importance ratings were *chapters* and *title* as high-importance features and *table of contents* and *pictures* as low-importance features in identifying the semantic representation of *book*.

The authors reported that the participants with left hemisphere-damage and aphasia exhibited reductions in identification of low-importance features, but not high-importance features, across word frequency levels. In addition, comprehension and naming performance showed significant correlations with low-importance feature knowledge in participants with aphasia. This study illustrated that semantic knowledge in persons with aphasia is influenced by the importance of semantic features. Cox (2009) has replicated the finding that individuals with aphasia have significantly more difficulty associating low-importance features than high-importance features with target low and mid frequency printed nouns. However, she also found that mid-importance features were not identified more accurately than were the low-importance features (although mid-importance features were identified less accurately than were the high-importance features).

**Feature Centrality**

Sloman, Love, and Ahn (1998) examined feature centrality in the normal population. The authors defined feature centrality as the degree to which a feature is essential or central to one’s mental representation of a semantic representation, or the degree to which the feature lends conceptual coherence to the categorical example. The authors determined feature centrality by looking at how the immutability of a feature
affects the internal structure of a semantic representation. For example, the authors argued that “a robin that does not eat is harder to imagine than a robin that does not chirp” (Sloman et al., 1998, p. 189); therefore, eating would be a more central feature to a robin than chirping.

Findings from the normal population suggest that features can be reliably ordered according to their necessity in defining semantic representations using tasks that require people to conceive objects missing a feature (Sloman et al., 1998). The authors used several tasks to measure feature centrality. Participants were asked to rate how surprised a person would be to encounter a category example that had atypical categorical features, the ease of imagining a category example that had atypical features, how good an example of a category would an example be that had atypical features, and how similar to an ideal of an example would be the category example be if it demonstrated atypical features.

Centrality has been investigated using normal adults. Findings have shown that normal adults are able to classify semantic features based on the notion of centrality. However, Cox (2009) has found that the ability of persons with aphasia to associate semantic features with target printed nouns is not influenced by the centrality rating of the semantic features.

Relevance of Features

Sartori and Lombardi (2004) looked at the relevance of semantic features of a semantic representation to investigate the issue of category specificity. Category-specific deficits involve impairment of members of some semantic categories such as animal or
fruits while knowledge of other categories such as furniture or clothes remain intact. Category-specific deficits have been widely researched and patients with category-specific deficits for both living and non-living items have been reported (Capitani, Laiacona, Mahon & Caramazza, 2003).

Sartori and Lombardi (2004) defined relevance as a measure of the contribution of semantic features to the core meaning of a semantic representation. The authors developed a mathematical procedure to map the relevance values of semantic features for 254 objects. For example, the authors found that the feature has a trunk was a highly relevant semantic feature for an elephant because most participants in the study used it when defining an elephant, but very few participants used it to define the other 253 objects. The authors also found that has four legs was used by few participants when defining elephant but was used by many participants when defining numerous other objects. Thus, has four legs was found to be a low relevance feature for an elephant. It is important to take into account that relevance values were calculated using all of the features produced for all 254 objects; thus, relevance values were dependent on the objects included in this study. Relevance values of specific features may have been drastically different if a different set of objects had been used. L. Scheffel (personal communication, February 4, 2009) is planning a study that might circumvent this concern.

In addition to mapping relevance ratings, Sartori and Job (1988) also found that living objects have lower relevance features than non-living objects. The authors suggested that this causes an advantage for non-living objects during word-retrieval tasks.
Findings showed that when living and nonliving categories were equated for relevance measures, category-specific deficits disappeared. The authors concluded that these findings suggest that those persons with category-specific semantic disorders are likely to be influenced by relevance of features.

**Distinctive Versus Shared Features**

The conceptual structure account (Tyler & Moss, 2001; Tyler, Moss, Durrant-Peatfield & Levy, 2000) was developed to examine the structure of semantic categories using data from the fields of neurological, behavioral, and development psychology. The authors placed theoretical emphasis on how semantic features are used to define semantic representations. The authors based the conceptual structure account on the notion that the relationship of the distinctiveness of functional and perceptual features varies across semantic categories and that the interaction of this relationship helps organize representations into semantic categories. In general, the conceptual structure account states that distinctive features are those that occur in only one or two examples in a category. Other features are shared across many examples in a category. Distinctive features can be viewed as features that are unique to a small set of category members. Shared or common features are those that can be used to define many members of the same semantic category (Tyler & Moss, 2001; Tyler, Moss, Durrant-Peatfield & Levy, 2000).

Randall, Moss, Rodd, Greer, and Tyler (2004) examined correlation and distinctiveness of semantic features in conceptual organization based on a hypothesis about category-specific deficits. This study focused on the conceptual structure account
(Tyler & Moss, 2001; Tyler et al., 2000) described above. According to authors of this account, distinctive features of representations in the living domain are vulnerable because of their weak correlation to other features. Using the assumption that mutual activation among correlated features produces faster activation in normal persons, the authors predicted a significant disadvantage for the distinctive features of living things versus nonliving things in normal adults.

Randall et al. (2004) asked forty-five normal adults to list all of the features that they could think of for 93 objects. The authors used the resulting feature list to calculate the distinctiveness of each feature and the correlation strength for features within a representation. As the authors predicted using the conceptual structure account, the correlation strength among distinctive features was significantly greater for nonliving things than for living things. The authors then asked twenty-six college students to participate in a speeded feature verification task. Results showed that normal adults had slower reaction times for verifying the distinctive features of living things than the distinctive features of nonliving things. A computational simulation supported the findings of the speeded feature verification task, with the authors concluding that normal adults showed differential performance for distinctive features of living versus nonliving examples in this study.

*Semantically Related Versus Unrelated Foils*

Given these findings, it is reasonable to ask if distinctive features of semantic representations are more vulnerable than shared features in persons with aphasia. Insight into the differential effects of distinctive versus shared features in the population with
aphasia can be gained by examining studies of comprehension involving the use of
semantically related versus semantically unrelated foils. Past research findings have
shown that persons with aphasia make more errors in comprehension tasks when
semantically related foils are used versus semantically unrelated foils (Butterworth,
Howard, & McLoughlin, 1984; Pierce, Jarecki, & Cannito, 1990). Commonly used tasks
include: picture and single word pointing tasks to auditory command.

Butterworth et al. (1984) asked 30 persons with aphasia to point to pictures on
auditory command both when the foils came from the same semantic category as the
target and when the foils were unrelated to the target picture. Array size for this study
was five pictures. The participants pointed to target pictures as accurately as did the
participants without aphasia when presented with semantically unrelated foils. However,
the participants with aphasia were significantly impaired when pointing to target pictures
that were presented with semantically related foils. The authors suggested this result
demonstrated that the semantic information made available to the participants with
aphasia was only superficial, making it difficult to differentiate between targets in the
same semantic category.

Grogan and Pierce (1994) found that semantic relatedness was a factor that also
significantly affected the ability to point to printed words on auditory commands in
persons with aphasia. Findings showed participants pointed to mid-frequency printed
nouns from an array of five unrelated foils with significantly greater accuracy than from
an array of five related foils. The authors stated that these results support the notion that
selecting among unrelated foils, which requires the comparison of only more general
semantic features, is more accurate than selecting among related foils, which requires the knowledge and appreciation of distinctive semantic features. In addition, Grogan and Pierce (1994) found that approximately half of the participants (7 of 13) demonstrated the effect of relatedness. Those who were affected and those who were not could not be differentiated based on age, education, and other identifying criteria.

Howland and Pierce (2004) examined the influence of semantic relatedness and array size on single-word reading comprehension in aphasia. Ten adults with aphasia were asked to match a spoken noun to a printed noun. The foils were systematically varied based on array size and semantic relatedness. The performance of the persons with aphasia with semantically related printed nouns was significantly worse than with unrelated printed nouns at all array sizes (arrays of two, four, six, and eight words). This finding further supports the notion that persons with aphasia are more impaired in their knowledge of distinctive features that are essential for choosing among related items.

Similarly to Grogan and Pierce (1994), Howland and Pierce (2004) also demonstrated that only about half of the participants with aphasia were affected by semantic relatedness. Six of the ten participants in the study performed more than 10 percent worse with related nouns than with unrelated nouns. This is consistent with Grogan and Pierce (1994) who found that approximately half of their participants with aphasia (54 percent) demonstrated the effect of relatedness.

Cole-Virtue and Nickels (2004) investigated several factors affecting performance on spoken word to picture matching. Fifty-four individuals with aphasia participated in this study. Ratings of semantic similarity were collected from twenty college students.
without aphasia. The authors asked the students to use a rating scale of 1-7 to reflect whether words were highly unrelated, moderately related, or highly related to target words used on the spoken word-picture matching subtest of the Psycholinguistic Assessments of Language Processing in Aphasia (PALPA) (Kay, Lesser, & Coltheart, 1992). Ratings from the college students were used to evaluate the performance of participants with aphasia.

Cole-Virtue and Nickels (2004) found that the rated semantic similarity between a target and a semantically related foil affected the performance of the participant group with aphasia. The participants showed improved performance on the PALPA spoken word-picture matching task (Kay et al., 1992) as the rated semantic similarity between the target and the foil decreased. In other words, the study found that the participants with aphasia were less accurate on items where the foil was rated as highly semantically similar to the target word.

These studies suggest that persons with aphasia have greater impairment for distinctive features than common features, but few studies have directly tested this assumption. Vecchi (1994) found that individuals with aphasia were more impaired in their knowledge of distinctive features than shared features. Feature knowledge was tested by having participants match features to target nouns presented in an array of three semantically unrelated nouns. However, Vecchi (1994) did not determine whether the participants with aphasia were able to choose among semantically related foils or not.

On the other hand, Germani and Pierce (1995) noted, when looking at importance of features in persons with aphasia, that many of the high-importance features appeared
to be distinctive. In fact, seventy-nine percent of the high-importance features were
distinctive in nature and sixty-five percent of the low-importance features were classified
as distinctive when a survey was completed by ten normal persons following the original
study. Findings did not support the notion that participants would have greater difficulty
with distinctive versus common feature knowledge since high-importance feature
knowledge was intact for participants in the study. However, it was not determined if the
persons with aphasia who participated in this study had difficulty selecting among related
foils.

A pilot study by Mason-Baughman and Pierce (2007) investigated the ability of
ten persons with aphasia to identify common and distinctive features as a function of
importance. Ability to choose among semantically related and unrelated foils was also
tested. Participants were asked to match high- and low-importance common and
distinctive features to a target noun presented in an array of four semantically unrelated
foils. In addition, participants were also asked to choose target nouns from an array of
four semantically unrelated foils and four semantically related foils. All features and
nouns were presented both visually and auditorily. Participants were divided into two
groups based on their ability to choose among related foils. Five of the ten participants
were able to choose among semantically related foils. These five participants correctly
identified twenty or more of the twenty-one targets. Five of the ten participants had
difficulty choosing among semantically related foils. These five participants correctly
identified sixteen or fewer of the twenty-one targets.
Findings from this study indicated a differential impairment of common versus distinctive feature knowledge in participants with aphasia. A significant main effect of importance was also found that replicated the findings of Germani and Pierce (1995) in that high-importance features were sorted more accurately than were low-importance features. There was a significant three-way interaction among the primary factors (common versus distinctive feature knowledge, feature importance, and ability to choose among semantically related foils) and significant main effects for common versus distinctive feature knowledge, feature importance, and group. The authors found that participants who had difficulty choosing among related foils had greater impairment with identification of low-importance distinctive features than participants who did not have difficulty choosing among related foils. A similar difference was not found for high-importance distinctive features. In addition, the study found that comprehension measures using subtests from the short version of the Boston Diagnostic Aphasia Examination Third Edition (BDAE-3) (Goodglass, 2001) and Boston Naming Test (BNT) (Kaplan, Goodglass, & Weintraub, 2001) were also significantly correlated with identification of low-importance distinctive features.

The findings from this study support the notion that the ability to select among semantically related foils is related to the individual’s knowledge and appreciation of low-importance distinctive semantic features. The participants with aphasia who had a greater appreciation for low-importance distinctive features demonstrated increased accuracy choosing among semantically related foils. Limitations of this pilot study identified by the authors include small sample size and limited stimuli corpus. Despite the
limitations, the findings show promise for future studies investigating the ability of persons with aphasia to identify common and distinctive features as a function of importance and ability to choose among semantically related and unrelated foils.

**Rationale and Research Questions**

The current review of the literature suggests that many persons with aphasia have more difficulty selecting a target noun from a set of semantically related foils than from a set of semantically unrelated foils. A logical interpretation of these findings is that these persons with aphasia have a greater impairment for distinctive features than common features (Mason-Baughman & Pierce, 2007). Vecchi (1994) showed that persons with aphasia have decreased distinctive feature knowledge, but Germani and Pierce’s (1995) results did not support the presence of a selective impairment in distinctive versus common feature knowledge in their participants. However, neither study determined if the participants with aphasia had difficulty selecting among related foils. The Mason-Baughman and Pierce (2007) pilot study suggested that participants with aphasia who had difficulty selecting among semantically related foils demonstrated greater impairment for low-importance distinctive features, but not high-importance distinctive features, when compared to participants who were able to choose among semantically related foils. Based on these findings, a need exists for additional research.

The purpose of the present study was to further investigate if the identification of distinctive versus common features of a lexical item is differentially impaired in persons with aphasia based on their ability to choose among semantically related foils and the importance rating of those features. If results replicate the pilot study, then one would
expect that the participants with aphasia will demonstrate greater impairment for distinctive features than for common features when the features are rated low-importance. In addition, the participants who have difficulty choosing among semantically related foils will have significantly more difficulty with the identification of low-importance distinctive features than participants who are able to accurately choose among related foils.

An additional purpose of the present study was to further investigate the role of importance in semantic feature knowledge. As indicated, the pilot study and Cox (2009) replicated the results of Germani and Pierce (1995) in that high-importance features were identified more accurately than were low-importance features. However, only Cox (2009) has investigated whether a third level of importance exists, that of mid-importance. She found that mid- and low-importance features presented similar levels of difficulty. The present study further investigated the role of mid-importance versus low-importance common and distinctive features.
CHAPTER II

METHODS

Participants

Ten adults with aphasia participated in this study. Their aphasia resulted from either one (N=6) or two (N=4) unilateral left hemisphere cerebral vascular accidents. All participants were right-handed native speakers and readers of English. In addition, all participants had no medical history of mental deterioration, such as dementia or right hemisphere syndrome, based on information from the referring speech-language pathologist and confirmation from each participant or family member. All participants demonstrated adequate visual and auditory skills as determined by their ability to pass a language screening test. The presence of aphasia was diagnosed by the referring licensed certified speech-language pathologist and confirmed by the investigator based on results of testing.

Participants completed subtests from the short version of the Boston Diagnostic Aphasia Examination Third Edition (BDAE-3) (Goodglass, 2001) and Boston Naming Test (BNT) (Kaplan, Goodglass, & Weintraub, 2001) to determine type and severity of aphasia. The Language Competency Index for each participant was calculated based on the results from the BDAE-3 and BNT to determine severity of aphasia. The Basic Word Discrimination subtest of the BDAE was used to compute the Language Competency Index and was also used to determine ability to choose among arrays of four semantically related picture foils. To ensure an adequate ability to read single words and short
phrases, participants completed a 16-item noun and phrase reading screening developed by the investigator. Participants were shown an array of four semantically unrelated printed nouns or phrases similar to those used in the experimental tasks and were asked to point to the one presented verbally. All nouns and features were printed in black ink on white cards using Arial Black 36-point font. The nouns and phrases consisted of both mid- and low-importance common and distinctive features. All participants who achieved an accuracy of 12 out of 16 items (75 percent) or better were included in the study. The criterion for inclusion in the study was used in previous research studies (Germani & Pierce, 1995; Mason-Baughman & Pierce, 2007). One person was excluded from the study based on this screening. See Appendix A for the reading screening items.

Table 1 contains the relevant identifying information and scores on the independent measures for each participant. Six females and four males participated in the study. Age ranged from 36 to 80 years (M=66.2 years, SD=13.3 years). One participant had a bachelor’s degree and the other nine had a high school diploma. Time post onset ranged from 8 months to 360 months (M= 91 months, SD=116.0 months). Participants were classified as having fluent or non-fluent aphasia based on analysis from the BDAE by the author and another licensed certified speech-language pathologist with experience with aphasia. Two participants had fluent aphasia and eight had non-fluent aphasia. Inter-judge agreement was 100 percent. Scores ranged from 0 pictures correctly named to 13 (M= 3.5 pictures, SD= 4.1 pictures) pictures correctly named on the BNT. Language Competency Indexes as computed from scores on the BDAE ranged from percentile of 6 to 78 (M= 33.4, SD= 27.2).
Table 1

*Participant Characteristics*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F/NF&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Age&lt;sup&gt;c&lt;/sup&gt;</th>
<th>TPO&lt;sup&gt;d&lt;/sup&gt;</th>
<th>Education&lt;sup&gt;e&lt;/sup&gt;</th>
<th>BNT&lt;sup&gt;f&lt;/sup&gt;</th>
<th>BDAE LCI&lt;sup&gt;g&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>F</td>
<td>66</td>
<td>82</td>
<td>HSD</td>
<td>13</td>
<td>78</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>NF</td>
<td>60</td>
<td>36</td>
<td>HSD</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>NF</td>
<td>74</td>
<td>72</td>
<td>HSD</td>
<td>3</td>
<td>55</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>NF</td>
<td>80</td>
<td>40</td>
<td>HSD</td>
<td>3</td>
<td>55</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>F</td>
<td>73</td>
<td>19</td>
<td>HSD</td>
<td>5</td>
<td>66</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>NF</td>
<td>79</td>
<td>240</td>
<td>HSD</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>NF</td>
<td>65</td>
<td>8</td>
<td>BS</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>NF</td>
<td>36</td>
<td>32</td>
<td>HSD</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>NF</td>
<td>74</td>
<td>360</td>
<td>HSD</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>M</td>
<td>NF</td>
<td>55</td>
<td>21</td>
<td>HSD</td>
<td>6</td>
<td>23</td>
</tr>
</tbody>
</table>

Mean | 66.2 | 91.0 | 3.5 | 33.4 |

SD | 13.3 | 116.0 | 4.1 | 27.2 |

<sup>a</sup>M=male, F=female

<sup>b</sup>F=fluent aphasia, NF=nonfluent aphasia

<sup>c</sup>Age in years

<sup>d</sup>Time post-onset in months

<sup>e</sup>HSD=high school diploma, BD=bachelor degree

<sup>f</sup>Boston Naming Test—shortened version (max=15)

<sup>g</sup>BDAE Language Competency Index (percentile max=100)
Development of Stimuli

The stimuli consisted of 29 low (<8/million) and mid (10-25/million) frequency of occurrence nouns selected from 63 nouns taken from the Francis and Kucera (1982) word-frequency list that already had importance ratings collected by Germani and Pierce (1995). See Appendix B for a list of stimuli. A pilot survey was completed to determine whether features of these 63 nouns were common or distinctive. A group of 20 adults, 6 males and 14 females, between the ages of 30 to 62 years old (M=43.9 years, SD= 11.7 years) with no history of aphasia or mental deterioration completed the survey.

Participants rated semantic features (e.g., has four legs, barks) as typical or not typical for different examples (e.g., cat, dog) within a category (e.g., animals, desserts, instruments). Individuals were given lists of five examples for various categories with several semantic features. Individuals were instructed to indicate if each of the semantic features was typical of each example. If the mean rating was that the feature was typical for only one or two of the five examples in the category, the feature was considered distinctive. If the mean rating was that the feature was typical for four or all five of the examples in the category, the feature was considered common. If the mean rating was that the feature was typical for three of the five examples in the category, the feature was considered neither common nor distinctive. Thus, a feature was classified as common if it had a mean rating of 4-5. Common features were those that were rated as typical for many or all examples within the same category. Similarly, a feature was classified as distinctive if it had a mean rating of 1-2. Distinctive features were those that were rated as typical for very few examples within the same category. Nouns that had at least one
mid-importance common (MIC) feature, mid-importance distinctive (MID) feature, low-importance common (LIC) feature, and low-importance distinctive (LID) feature were used in the experimental task. Results from both Germani and Pierce (1995) and Mason-Baugham and Pierce (2007) showed that participants with aphasia were not impaired with high-importance feature knowledge. Thus, the present study examined only mid- and low-importance common and distinctive semantic features.

Materials

Twenty-nine nouns met the criteria for inclusion in the study and were presented in a pseudo-randomized order with no more than 2 nouns within a category being adjacent. For each of the nouns there was one MIC, MID, LIC, LID, and one unrelated feature. All nouns and features were printed in black ink on white cards using Arial Black 36-point font for the experimental task. No participants from the pilot study (Mason-Baugham & Pierce, 2007) had difficulty seeing the printed nouns and features using this font size and style. See Table 2 for an example of the stimuli used. Appendix C contains the complete list of target items and features.
Table 2

*Example of Stimulus Items*

<table>
<thead>
<tr>
<th></th>
<th><em>Strawberry</em></th>
<th><em>Violin</em></th>
<th><em>Cigar</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>MIC</td>
<td>Pick them</td>
<td>Play it</td>
<td>Puff on it</td>
</tr>
<tr>
<td>MID</td>
<td>Cone shaped</td>
<td>Has 4 strings</td>
<td>Rolled tobacco leaves</td>
</tr>
<tr>
<td>LIC</td>
<td>Sweet</td>
<td>Music</td>
<td>Makes you cough</td>
</tr>
<tr>
<td>LID</td>
<td>On shortcake</td>
<td>Play with fingers</td>
<td>Birth of baby</td>
</tr>
</tbody>
</table>

*Procedures*

The experimental task was divided into three stages. All stages were completed on the same day of testing following completion of the preliminary tests listed in the *participants* section. In stage 1, participants were shown a horizontal array of four printed nouns and instructed to point to the word presented auditorily. One of the nouns corresponded to the target, and the other three were unrelated to the target semantically or perceptually. The location of the target noun within the array was randomized within the task with no more than two consecutive arrays with the target noun having the same location within the array (i.e., first, second, etc.). This stage of testing was included to demonstrate that the participants had at least some understanding of the stimulus nouns. The first 21 nouns correctly identified in stage 1 were used for the experimental tasks in
stage 2 and stage 3 for each participant. Accordingly, the make-up of the 21 stimuli varied slightly across participants.

Stage 2 involved a sorting task using 21 nouns correctly identified in stage 1. Three target nouns were placed horizontally in front of each participant along with a fourth card containing the word “UNRELATED”. Participants were given a deck of 15 feature cards containing one MIC, one MID, one LIC, one LID, and one unrelated feature for each noun (5 features x 3 target nouns= 15 cards). Participants were instructed to sort the deck of 15 cards into one of the four designated piles. The 3 targets and “UNRELATED” cards were read aloud by the examiner at the beginning of the task. The nouns and phrases on the feature cards were read aloud by the examiner as they were sorted. Once a card was sorted by the participant, it was removed from the table. This sorting task was repeated seven times for each participant for a total of 21 target nouns. The three target nouns in each sorting array were randomly selected with the limitation that the nouns were not members of the same category or semantically related.

Participants were trained for this sorting task using common nouns sorted into broad categories (colors, shapes, drinks, unrelated). See Appendix D for the sorting screening. Category names and examples were read aloud similar to the experimental sorting task. Participants sorted from groups of 8 examples. A criterion of 7/8 correctly sorted was reached before the participant began the experimental sorting task. If the participant did not reach criterion with the first eight examples, directions were repeated and 8 new examples were used. All ten participants reached criterion within two trials and proceeded to the experimental sorting task.
The same 21 target nouns used in stage 2 were then used in a task involving choosing among semantically related foils in stage 3. Participants were shown a horizontal array of four printed nouns and instructed to point to the word presented auditorily. One of the nouns corresponded to the target, and the other three were semantically related to the target. The location of the target noun within the array was randomized within the task with no more than two consecutive arrays with the target noun having the same location within the array (i.e., first, second, etc.).

Completion of stage 3 divided the participants into two groups: those who had difficulty choosing among related foils and those who were able to choose among related foils. Based on results of the pilot study (Mason-Baughman and Pierce, 2007), the criterion for having the ability to choose among related foils was at least 85 percent accuracy. The criteria for having difficulty choosing among related foils was less than 65 percent accuracy. There were five participants in each group. Five of the ten participants correctly identified at least 18 of the 21 semantically related targets, and five of the ten participants correctly identified 13 or fewer of the 21 semantically related targets. Table 3 lists the participants by group.
Table 3

Grouping of Participants Based on the Number of Correct Nouns Identified from Related Foils

<table>
<thead>
<tr>
<th>Participant number</th>
<th>Group$^a$</th>
<th>Number correct$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AC</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>AC</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>AC</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>AC</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>AC</td>
<td>21</td>
</tr>
<tr>
<td>6</td>
<td>DC</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>DC</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>DC</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>DC</td>
<td>11</td>
</tr>
<tr>
<td>10</td>
<td>DC</td>
<td>13</td>
</tr>
</tbody>
</table>

$^a$ AC=Ability to choose among related foils, DC=Difficulty choosing among related foils

$^b$ Max=21
CHAPTER III

RESULTS

Table 4 contains the mean scores for the experimental conditions. A three-way ANOVA with one between-subjects factor (group) and two within-subjects factors (importance and commonality versus distinctiveness [c/d]) was employed to compare the mean scores. The main effect for group was statistically significant, $F(1,8)=6.72$, $p=0.03$. However, the main effects for importance and c/d were not, $F(1,8)=0.06$, $p=0.82$ and $F(1,8)=2.34$, $p=0.16$ respectively. The interaction between group and c/d was also statistically significant, $F(1,8)=7.29$, $p=0.03$. None of the other two-way interactions or the three-way interaction were significant. See Table 5 for the ANOVA results. Raw scores for each participant are listed in Appendix E.
Table 4

*Means and Standard Deviations for Scores in the Experimental Conditions Including Feature Importance and Feature Commonality Versus Distinctiveness for the Participants Who Could Choose Among Related Foils (AC, N=5) and Those Who Had Difficulty Choosing Among Related Foils (DC, N=5)*

<table>
<thead>
<tr>
<th>Group</th>
<th>Mid-Importance</th>
<th>Low-Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Common</td>
<td>Distinctive</td>
</tr>
<tr>
<td>AC</td>
<td>15.6</td>
<td>16.4</td>
</tr>
<tr>
<td></td>
<td>2.7</td>
<td>0.9</td>
</tr>
<tr>
<td>DC</td>
<td>12.0</td>
<td>10.6</td>
</tr>
<tr>
<td></td>
<td>3.4</td>
<td>3.4</td>
</tr>
</tbody>
</table>
Table 5

Results of the Three-Way Mixed ANOVA (N=10)

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Effect Size</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>1,8</td>
<td>0.46</td>
<td>136.90</td>
<td>6.72</td>
<td>0.03</td>
</tr>
<tr>
<td>Importance</td>
<td>1,8</td>
<td>0.01</td>
<td>0.40</td>
<td>0.06</td>
<td>0.82</td>
</tr>
<tr>
<td>C/d(^1)</td>
<td>1,8</td>
<td>0.23</td>
<td>6.40</td>
<td>2.34</td>
<td>0.16</td>
</tr>
<tr>
<td>Group X importance</td>
<td>1,8</td>
<td>0.15</td>
<td>10.00</td>
<td>1.43</td>
<td>0.28</td>
</tr>
<tr>
<td>Group X c/d</td>
<td>1,8</td>
<td>0.48</td>
<td>19.60</td>
<td>7.29</td>
<td>0.03</td>
</tr>
<tr>
<td>Importance X c/d</td>
<td>1,8</td>
<td>0.09</td>
<td>2.5</td>
<td>0.77</td>
<td>0.41</td>
</tr>
<tr>
<td>Group X importance X c/d</td>
<td>1,8</td>
<td>0.03</td>
<td>0.09</td>
<td>0.28</td>
<td>0.61</td>
</tr>
</tbody>
</table>

\(^1\) c/d = commonality versus distinctiveness

Table 6 contains mean scores for the two-way interaction of group by commonality versus distinctiveness of features (also see Figure 2). Results from a t-test showed a statistically significant difference for distinctive features between groups, \(t(8)=4.06, p=0.00\). There was not a significant difference for common features between groups, \(t(8)=1.32, p=0.24\). Paired sample t-tests were used to determine whether differences between common and distinctive features were significant for either group separately. The t-test revealed statistically significant differences, \(t(4)= 4.09, p=0.02\), for the group who had difficulty choosing among semantically related foils (DC). Distinctive features were identified significantly less accurately than were common features. The t-test revealed no significant differences, \(t(4)= -0.68, p=0.54\), for the group who did not have difficulty choosing among semantically related foils (AC).
Table 6

*Means and Standard Deviations for the Two-Way Interaction of Group (AC, N=5 and DC, N=5) by Commonality Versus Distinctiveness (c/d) of Features*

<table>
<thead>
<tr>
<th>Group</th>
<th>Common</th>
<th>Distinctive</th>
<th>within-group differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Mean 30.6</td>
<td>31.8</td>
<td>not significant</td>
</tr>
<tr>
<td></td>
<td>SD 1.0</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>DC</td>
<td>Mean 26.0</td>
<td>21.6</td>
<td>P=0.02</td>
</tr>
<tr>
<td></td>
<td>SD 1.8</td>
<td>5.2</td>
<td></td>
</tr>
</tbody>
</table>

*between-group differences*

Not significant

Figure 2. Mean number of correct scores by feature condition (common versus distinctive) and group (AC versus DC).
The results showed that the group who were able to choose among semantically related foils performed similarly on the common and distinctive feature identification tasks. In contrast, the group who had difficulty choosing among semantically related foils performed significantly worse on the distinctive feature identification task than the common feature identification task. In addition, this group performed significantly worse on the distinctive feature identification task than the group who were able to choose among related foils. Importance was not a significant condition when comparing mid-importance to low-importance features.

To investigate the relationship between feature knowledge and comprehension and naming skills, correlations were computed among scores on the common and distinctive feature identification tasks, BDAE Language Competency Index, BNT, related foils task from Stage 3 of the experimental task, and ability to choose among semantically related picture foils as determined from scores on the Basic Word Discrimination subtest from the BDAE. Table 7 shows the correlation matrix. Significant correlations were observed among the BDAE Language Competency Index, related foils task, and picture foils task. These significant correlations indicate that the participants’ performances on these measures of comprehension and naming are interrelated and presumably related to participant’s overall severity of aphasia. Participant scores on the distinctive features condition correlated significantly with the BDAE Language Competency Index ($r=0.72, p=0.02$), the related foils task ($r=0.74, p=0.01$), the picture foil task ($r=0.71, p=0.02$). These significant correlations indicate that the better the participants’ auditory comprehension and their ability to choose among both written
and picture foils that were semantically related, and the less severe their aphasia, the more accurately they could identify distinctive features for the targets in the present study. Participant scores did not correlate significantly on distinctive feature identification and the BNT ($r=0.43$, $p=0.40$); however, there was a significant correlation between low-importance distinctive feature identification and the BNT in the pilot study ($r=0.86$, $p=0.00$). Participant scores on the common features condition did not significantly correlate with the BDAE Language Competency Index, BNT, related foils task, or the picture foils task.

The correlation between the related foils task from Stage 3 of the experimental task and the picture foils task ($r=0.87$, $p=0.00$) strengthens the appropriateness of the groupings of ability to choose among related foils and difficulty choosing among related foils. Those who had difficulty choosing among related foils demonstrated difficulty with the task with the use of both written nouns and pictured objects. Those who were able to choose among semantically related foils were able to do so with use of both written nouns and pictured objects.
Table 7

*Correlations among Participants’ Scores (N=10)*

<table>
<thead>
<tr>
<th></th>
<th>Distinctive&lt;sup&gt;b&lt;/sup&gt;</th>
<th>LCI</th>
<th>BNT&lt;sup&gt;d&lt;/sup&gt;</th>
<th>FoilsTask&lt;sup&gt;e&lt;/sup&gt;</th>
<th>PicFoils&lt;sup&gt;f&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Common&lt;sup&gt;a&lt;/sup&gt;</strong></td>
<td>0.76** (p=0.01)</td>
<td>0.41</td>
<td>0.00</td>
<td>0.39</td>
<td>0.42</td>
</tr>
<tr>
<td><strong>Distinctive</strong></td>
<td>-</td>
<td>0.72* (p=0.02)</td>
<td>0.43</td>
<td>0.74** (p=0.01)</td>
<td>0.71* (p=0.02)</td>
</tr>
<tr>
<td><strong>LCI</strong></td>
<td>-</td>
<td>0.75* (p=0.01)</td>
<td>0.85** (p=0.01)</td>
<td>0.80** (p=0.01)</td>
<td></td>
</tr>
<tr>
<td><strong>BNT</strong></td>
<td>-</td>
<td>0.71* (p=0.02)</td>
<td></td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td><strong>Foils Task</strong></td>
<td>-</td>
<td></td>
<td></td>
<td>0.87** (p=0.00)</td>
<td></td>
</tr>
</tbody>
</table>

** p<0.01 (two-tailed test)

* p<0.05 (two-tailed test)

<sup>a</sup> Common feature identification

<sup>b</sup> Distinctive feature identification

<sup>c</sup> Boston Diagnostic Aphasia Examination Language Competency Index

<sup>d</sup> Boston Naming Test

<sup>e</sup> Related foils task from Stage 3 of Experimental Task

<sup>f</sup> Semantically related picture foil task (*Basic Word Discrimination* Subtest) from Boston Diagnostic Aphasia Examination
CHAPTER IV
DISCUSSION

The results of the present study showed that the group who were able to choose among semantically related foils performed similarly on the common and distinctive feature identification tasks. On the other hand, the group who had difficulty choosing among semantically related foils performed worse on the distinctive feature identification task than the common feature identification task. In addition, this group performed significantly worse on the distinctive feature identification task than the group who were able to choose among related foils. Unlike the results from the pilot study (Mason-Baughman & Pierce, 2007), importance was not a significant condition when comparing mid-importance to low-importance features as it was when comparing high-importance to low-importance features.

This chapter will discuss these findings. First, the notion that distinctive feature knowledge impacts the ability to choose among semantically related foils will be discussed. The differing results of the role of high importance versus mid- and low-importance from the pilot study and present study will then be examined. Also, the result that although high-importance distinctive (HID) feature knowledge remained relatively intact for the participants in the pilot study, half of the participants still had difficulty choosing among related foils will be reviewed in greater detail. Finally, clinical implications, limitations of the study, and future research will be addressed.
Distinctive Feature Knowledge and Ability to Choose Among Related Foils

The results of the present study and pilot study support the idea that even when persons with aphasia demonstrate comprehension of a word by accurately selecting it among an array of semantically unrelated foils, they do not necessarily have a complete semantic representation of the word. They may have only a partial semantic representation of the word. This distinction between having a partial semantic representation versus a complete semantic representation is partially reflected in the differential impairment of common versus distinctive feature knowledge and the difficulty in choosing among semantically related foils shown in both the current study and the pilot study.

Past research further supports this impairment in distinguishing among related items by showing that when persons with aphasia made errors in forced-choice comprehension tasks, they often chose a semantically related foil (Gainotti, Caltegirone, & Masullo, 1981). In addition, Butterworth et al. (1984) and Pierce et al. (1990) reported that many persons with aphasia have greater difficulty choosing among related foils than unrelated foils with an array of four or more pictures or written words. Butterworth et al. (1984) interpreted these results as an indication that some persons with aphasia have only partial semantic representations, in that they can identify common features for items in a category but have difficulty with distinctive features. Knowledge of common features, or having only a partial semantic representation, is sufficient for selecting among unrelated foils but not related foils. For example, having the featural information has four legs may be enough to allow a person to choose dog from an array including, house, car, shirt, but
it would not provide a rich enough representation to allow a person to choose *dog* from an array including, *cat, horse, elephant*. The results of both the pilot study and present study further reinforce this interpretation in that those persons with aphasia who had difficulty choosing among related foils also had significantly worse knowledge of distinctive features.

This relationship of comprehension ability to feature knowledge was further investigated using correlations. Scores on measures of comprehension correlated significantly with scores on distinctive feature knowledge but not with scores on common feature knowledge. This finding further supports the notion that knowledge of distinctive features contributes significantly to the comprehension abilities of persons with aphasia. These results expanded on Goodglass and Baker (1976) who found that persons with aphasia with lower comprehension abilities identified significantly fewer semantic features than those with higher comprehension abilities. In summary, the findings of both the pilot study and the present study support the notion that persons with aphasia with higher comprehension abilities have more intact lexical semantic representations, particularly in distinctive feature knowledge. This enhanced knowledge allows them to more successfully choose a targeted picture or word from an array of semantically related stimulus items.

Having more intact lexical semantic representations, particularly in distinctive feature knowledge, may also impact naming abilities in persons with aphasia. In the pilot study, there was a significant correlation between scores on the BNT and low-importance distinctive feature identification. In the present study, there was not a significant
correlation between scores on the BNT and distinctive feature identification. This result could be due to the differences in participants in the pilot study versus the present study. In the pilot study, six of the participants were rated as having fluent aphasia and the Language Competency Indexes were much higher. In the present study, only two participants were rated as having fluent aphasia and the mean Language Competency Indexes were much lower. Accordingly, the higher incidence of non-fluent aphasia may reflect a greater contribution of motor-based influences that impacted the relationship between naming abilities and distinctive feature knowledge.

*High-Importance Feature Knowledge versus Mid- and Low-Importance Feature Knowledge*

The pilot study found differential impairment for the low-importance distinctive (LID) features for only those persons with aphasia who had difficulty choosing among related foils. The group that was able to choose among semantically related foils had relatively intact high-importance common (HIC) feature knowledge, low-importance common (LIC) feature knowledge, and high-importance distinctive (HID) feature knowledge. Although LID feature knowledge appeared less intact for this group, it was not significantly more impaired. However, LID feature knowledge was significantly more impaired for the group who had difficulty choosing among semantically related foils. This finding reinforces the Germani and Pierce (1995) results that semantic feature knowledge in persons with aphasia is influenced by the levels of high versus low importance. Thus, it appears that distinctive semantic features can be divided into two
levels of difficulty (high and low importance), at least for those persons with aphasia who have difficulty choosing among semantically related foils.

The findings from both the pilot study and present studies are consistent with Cox (2009) who found that high importance features were sorted more accurately than both mid- and low-importance features. Mid- and low-importance features were sorted with similar degrees of accuracy. In contrast, in the present study, importance was not a significant condition. The mid- and low-importance feature conditions were of equivalent difficulty. Accordingly, the hierarchy of semantic feature knowledge cannot be extended to a third level of difficulty, that of a mid level of importance.

The comparatively high accuracy with high-importance features may relate to a greater percentage of superordinate features. To further explore this notion, the nature of the common features will be considered. Distinctive features will not be considered because, by definition, they do not contain superordinates.

Fifty-seven percent of the HIC features in the pilot study were superordinate or categorical in nature (e.g. instrument was rated as a HIC feature for violin). In the present study, 31 percent of the MIC features were superordinate or categorical in nature. In both studies, less than 5 percent of the LIC were superordinate in nature. In the present study, 70 percent of the MIC features that were superordinate or categorical in nature were correctly identified. Only 64 percent of the MIC features that were non-superordinate in nature were correctly identified. In the pilot study, 80 percent of the HIC features that were superordinate or categorical in nature were correctly identified, whereas, 76 percent of the HIC that were non-superordinate were correctly identified. Results from Goodglass
and Baker (1976) also showed that both participants with aphasia with high comprehension abilities and participants with aphasia with low comprehension abilities were able to more accurately identify superordinate semantic features than other non-superordinate features.

It appears that knowledge of superordinate features is more intact in persons with aphasia than is knowledge of non-superordinate features. Accordingly, the relatively good performance with high-importance features compared to mid- and low-importance features may have occurred because high-importance features have a greater number of superordinates which is a more intact aspect of semantic knowledge. However, additional research is needed to better explain these results. By comparing HIC features that are and are not superordinates in a similar study or by directly comparing identification of HIC superordinate features to MIC superordinate features in the same study, one could better determine the underlying cause of this finding.

*The Role of HID Feature Knowledge in Choosing Among Related Foils*

In the pilot study, HID feature knowledge remained relatively intact for both the group who were able to choose and the group who had difficulty choosing among semantically related foils. Despite the relatively intact HID feature knowledge, half of the participants still had difficulty choosing among semantically related foils. This raises the issue of why some of the participants had difficulty choosing among related foils despite having some intact distinctive feature knowledge. For example, some participants successfully associated the HID feature *blow in it* with *trumpet* but still could not choose *trumpet* from a set of foils including *violin, drum, piano.*
Apparently, knowing some distinctive features, even the high importance ones, is not sufficient for choosing among related foils. Semantic representations need to be more fully developed (e.g., with mid- and low-importance distinctive features) in order to support the ability to successfully choose among related foils. Accordingly, the interpretation by some (e.g., Butterworth et al., 1984; Cole-Virtue & Nickels, 2004; Grogan & Pierce, 1994; Howland & Pierce, 2004) that the semantic representations of individuals with aphasia who have difficulty choosing among related foils are superficial can be clarified. Semantic representations containing some distinctive features can still be superficial. More developed representations appear to require the appreciation of a larger number of distinctive features. Only these more fully developed representations allow individuals with aphasia to accurately choose among related foils.

Another interpretation of this finding might relate to the notion of distinctiveness. While the HID feature dough for cookie might be distinctive when presented with food foils such as, cereal, rice, apple; it is not distinctive for other subsets of foods such as pie, pizza, bread. Perhaps when seeing and hearing the target word cookie, some participants with aphasia conjured up associated desserts (e.g., pie, cinnamon roll). The feature dough was no longer distinctive and confusion occurred. Those participants with aphasia who had more developed semantic representations that included the LID feature of dip in milk could distinguish among the actual choices and the conjured ones so confusion did not occur. Thus, knowledge of mid- and low-importance distinctive features facilitates choosing among foils that are related at a number of different categorical levels.
In conclusion, participants in the pilot study who had intact HID and LID featural information were able to choose among semantically related foils. Participants who only had intact HID featural information had difficulty choosing among related foils. These results show that having LID featural information available during related foils tasks allows for more accurate selection among targets from the same semantic categories, especially when the foils are all from a more defined subcategory. In general, persons with aphasia often have deficits in semantic representations. If these semantic representations are not relatively intact, persons with aphasia will have difficulty on related foil tasks as did half of the participants in both the present and pilot studies.

Clinical Implications

Several treatments for aphasia, such as Semantic Feature Analysis, are used to improve the patient’s lexical-semantic representations by training feature knowledge. Semantic Feature Analysis prompts the patient to produce features that describe group, use, action, properties, location, and association (Boyle & Coelho, 1995; Coelho, McHugh & Boyle, 2000; Conley & Coelho, 2003; Boyle, 2004). Common features would be used to describe group and perhaps many of the other cue areas. As mentioned in Chapter I, SFA treatment does not always result in generalization to connected speech. Perhaps by focusing more on distinctive features during treatment, more generalization to both untrained items and connected speech would be noted. By improving distinctive feature knowledge through therapeutic techniques, persons with aphasia may regain more complete lexical-semantic representations and minimize the underlying semantic knowledge deficit so often seen in this population.
Another related therapy approach is Typicality Treatment (Kiran, 2007; Kiran, 2008). Using exercises that activated semantic features for target stimuli, Kiran and Thompson (2003) treated naming ability in four participants with aphasia using typical and atypical category examples. The authors treated two participants using only typical category exemplars (e.g., robin for the category birds, carrot for the category vegetables) with improved naming noted only for trained items. The authors treated the other two participants using only atypical category exemplars (e.g., ostrich for the category birds, asparagus for the category vegetables) with improvement noted for both trained items and untrained typical category exemplars.

In general, Kiran and Thompson (2003) found that training atypical items within categories rather than more typical items resulted in greater generalization to untrained items. The authors felt that the training of typical items, such as robin for the semantic category birds, stressed the more common features for the category with little emphasis on distinctive features. On the other hand, training of more atypical exemplars, such as ostrich, emphasized retrieval of both common and distinctive feature knowledge. By addressing distinctive feature knowledge, the participants in the study were able to reactivate more complete lexical-semantic representations that helped improve naming abilities. This notion that focusing on distinctive feature knowledge during treatment resulted in richer lexical-semantic representation was further reinforced in that the participants in the study also improved on measures of auditory comprehension following the atypical exemplar training according to the authors. Naming treatments focused on improving distinctive feature knowledge may in actuality also improve the underlying
semantic knowledge deficit seen in many persons with aphasia. Kiran’s research, along with the present study, support the emphasis on distinctive features in the treatment of semantic knowledge in persons with aphasia. Enhanced semantic knowledge could lead to improved comprehension and naming abilities.

Limitations of the Study

The findings from the present study could be strengthened in future studies. Ideally, a larger sample size should be used. However, significant findings did result with only ten participants in both the pilot study and present study. In addition to a larger sample size, a greater corpus of HIC, HID, MIC, MID, LIC, and LID features need to be determined from the normal population. The current study was limited due to the use of targets that already had importance ratings from Germani and Pierce (1995). The experimental task used in the present study was also very similar to the experimental tasks used in both Germani and Pierce (1995) and the pilot study. Another task could be utilized in future studies to ensure that the results are not task-dependent. In addition to a greater corpus of features and different task, the ratings of the features in both the pilot study and present study were dependent on the exemplars and categories used. The ratings may change with combinations of different exemplars within categories.

The dependence on exemplars selected for ratings is not a weakness exclusive to just the current study. When Sartori and Lombardi (2004) investigated feature relevance, their study was also limited by the relevance values being dependent on the examples selected for the study. Like the present study, the ratings may have differed if a different set of category exemplars were used. Other studies examining distinctive versus shared
features have also been limited by the set of exemplars selected (Tyler & Moss, 2001; Tyler, Moss, Durrant-Peatfield & Levy, 2000).

All studies investigating common versus distinctive feature knowledge would be limited by the category exemplars selected for inclusion in the study. For example, the broad category of animals can be subdivided into farm animals, forest animals, zoo animals, and jungle animals. If exemplars from each subcategory are grouped together for rating purposes (e.g., cow, deer, elephant, lion), then subcategory features (e.g., farm animal) would likely be rated as distinctive in nature. However, if only farm animals are grouped together for ratings purposes, the feature farm animal would likely be rated as common in nature. To try to control for this phenomenon, the current author used varied exemplars within broad categories to best try to achieve the most accurate ratings of commonality and distinctiveness. For example, exemplars from the subcategories of farm animals, forest animals, and zoo animals were all grouped under the broad category of animals so that only the most common featural descriptions such as animal, breathes, and has four legs would be considered common.

Future Studies

Future studies with larger sample sizes and larger corpuses of features would be beneficial in providing more information about lexical-semantic featural representations in persons with aphasia. In addition, using a different experimental task, such as having participants use a yes or no response to indicate if a feature from a list of features is associated with a target, would show that the present results are not dependent on the sorting task utilized in Germani and Pierce (1995), the pilot study, and the present study.
By focusing on distinctive feature knowledge during aphasia treatments, timelier and greater generalization may result. Accordingly, future research should investigate the comparative effectiveness of treatments that emphasize distinctive versus common features.

**Conclusion**

The findings of the present study support the theories of semantic processing presented in the introduction. Semantic feature knowledge can be organized according to importance and commonality versus distinctiveness of features. When errors occur with the activation or processing of semantic representations for low- and mid-importance distinctive features, errors in comprehension and naming may occur. In summary, the results of the present study suggest a differential impairment of common versus distinctive feature knowledge in persons with aphasia. Participants who had difficulty choosing among semantically related foils were significantly more impaired in their appreciation of distinctive semantic features than those who were able to choose among related foils. In addition, comprehension abilities correlated significantly with distinctive but not common feature knowledge. High-importance distinctive features were appreciated more accurately than low-importance features (pilot study); however, mid-importance features were not (present study). These current findings support the notion that distinctive feature knowledge contributes in a significant way to the integrity of semantic representations in persons with aphasia, which can influence their comprehension and, perhaps, naming abilities.
APPENDIXES
APPENDIX A

Reading Screening Items
Reading Screening Items

Nouns:

- stem (MIC)
- dessert (MIC)
- laces (MID)
- antlers (MID)
- metal (LIC)
- diamonds (LIC)
- toy (LID)
- wood (LID)

Phrases:

- different sizes (MIC)
- on construction site (MIC)
- dark red (MID)
- good for eyes (MID)
- hold in hands (LIC)
- used in desserts (LIC)
- in a jar (LID)
- metallic colors (LID)
APPENDIX B

Stimulus List
Stimulus List

1. strawberry
2. camel
3. crayon
4. violin
5. cookie
6. alligator
7. cigar
8. drum
9. banana
10. tiger
11. rocket
12. grapefruit
13. rose
14. cereal
15. binoculars
16. bracelet
17. monkey
18. potato
19. egg
20. pipe
Stimulus List (continued)

21. hammer
22. daisy
23. pie
24. lemon
25. bucket
26. jelly
27. apple
28. fox
29. skunk
APPENDIX C

Targets with Features
Targets with Features

1. Strawberry
   MIC  pick them
   MID  cone shaped
   LIC  sweet
   LID  on shortcake

2. Camel
   MIC  drinks water
   MID  long legs
   LIC  mammal
   LID  ship of the desert

3. Crayon
   MIC  create pictures
   MID  coloring book
   LIC  in art class
   LID  stay in the lines

4. Violin
   MIC  play it
   MID  has 4 strings
   LIC  music
   LID  play with fingers
Targets with Features (continued)

5. Cookie

MIC  junk food
MID  girl scouts sell them
LIC  calories
LID  dip in milk

6. Alligator

MIC  carnivores
MID  in swamps
LIC  hunters
LID  eyes on top of head

7. Cigar

MIC  puff on it
MID  rolled tobacco leaves
LIC  makes you cough
LID  birth of baby

8. Drum

MIC  music
MID  hit with sticks
LIC  in orchestra
LID  sit down to play
Targets with Features (continued)

9. Banana
   MIC nutritious
   MID in a bunch
   LIC things we eat
   LID monkeys like it

10. Tiger
    MIC warm blooded
    MID stripes
    LIC mammal
    LID claws

11. Rocket
    MIC fuel
    MID launched
    LIC steel
    LID go to the moon

12. Grapefruit
    MIC food
    MID rind
    LIC diet
    LID eaten with a serrated spoon
Targets with Features (continued)

13. Rose

MIC needs sunlight
MID long stem
LIC green leaves
LID red means love

14. Cereal

MIC breakfast
MID eat with a spoon
LIC in kitchen cabinet
LID flakes

15. Binoculars

MIC put up to eyes
MID field glasses
LIC breakable
LID used to spy

16. Bracelet

MIC accessory
MID dangles on wrist
LIC gold
LID hard to put on yourself
Targets with Features (continued)

17. Monkey
   MIC mammal
   MID eats bananas
   LIC 4 legs
   LID in the zoo

18. Potato
   MIC grow
   MID spud
   LIC cut it
   LID au gratin

19. Egg
   MIC things we eat
   MID cracks
   LIC in kitchen
   LID poach

20. Pipe
   MIC smoke comes out
   MID hold bowl in hand
   LIC lit by match
   LID corn cob
Targets with Features (continued)

21. Hammer
   MIC   in tool box
   MID   bang it
   LIC   in garage
   LID   hit thumb

22. Daisy
   MIC   green leaves
   MID   white petals
   LIC   beautiful
   LID   wild flower

23. Pie
   MIC   flour
   MID   flaky crust
   LIC   sugar
   LID   fruit filling

24. Lemon
   MIC   produce
   MID   lemonade
   LIC   flavor of candy
   LID   cut in wedges
Targets with Features (continued)

25. Bucket
   MIC  cleaning equipment
   MID  carry water in it
   LIC  in house
   LID  lip for pouring

26. Jelly
   MIC  buy in store
   MID  smashed fruit
   LIC  breakfast
   LID  inside doughnuts

27. Apple
   MIC  skin
   MID  white pulp
   LIC  taste good
   LID  squeeze for cider

28. Fox
   MIC  tail
   MID  eats chickens
   LIC  long tail
   LID  sly
Targets with Features (continued)

29. Skunk

MIC  eyes
MID  avoid it
LIC  teeth
LID  mean
APPENDIX D

Sorting Screening
Sorting Screening

- Colors
  - yellow
  - red
  - green
  - blue

- Shapes
  - rectangle
  - square
  - circle
  - triangle

- Drinks
  - iced tea
  - soda
  - milk
  - coffee

- UNRELATED
  - daisy
  - monkey
  - stove
  - bathroom
APPENDIX E

Raw Data Used for ANOVA
### Raw Data Used for ANOVA

<table>
<thead>
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<th>Participant</th>
<th>Group&lt;sup&gt;a&lt;/sup&gt;</th>
<th>MIC&lt;sup&gt;b&lt;/sup&gt;</th>
<th>MID&lt;sup&gt;c&lt;/sup&gt;</th>
<th>LIC&lt;sup&gt;d&lt;/sup&gt;</th>
<th>LID&lt;sup&gt;e&lt;/sup&gt;</th>
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</table>

<sup>a</sup> AC=Able to choose among related foils, DC=Difficulty choosing among related foils

<sup>b</sup> Mid-importance common features

<sup>c</sup> Mid-importance distinctive features

<sup>d</sup> Low-importance common features

<sup>e</sup> Low-importance distinctive features

Max score=21
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